

Markscheme

November 2019

Biology

Higher level

Paper 3

38 pages

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Section A

Question		Marking point	Answers	Notes	Total
1.	a		<i>Similarities [1 max]</i>		2 max
		a	both have similar design «input and output» ✓		
		b	both open systems ✓		
			<i>Differences [1 max]</i>		
		c	vertical flow/«figure» A has pump but horizontal flow/«figure» B does not/flows naturally ✓	<i>Do not accept references to rate of flow or pressure as they are unknown.</i>	
		d	horizontal flow/«figure» B has a larger «surface» area OR horizontal flow/«figure» B has more plants ✓	<i>Accept vice versa.</i>	
		e	vertical flow/«figure» A has a pre-treatment «with sedimentation tank» before treatment but not horizontal flow/«figure» B ✓	<i>Accept vice versa.</i>	
	b	a	horizontal flow/«figure» B because it is larger OR horizontal flow/«figure» B contains more/several plants ✓		1 max
		b	horizontal flow/«figure» B because it works by natural flow OR horizontal flow/«figure» B because it works without a pump ✓	<i>Do not accept river instead of flow.</i>	

(continued...)

(Question 1 continued)

c	a	type/number of plants ✓	<i>If more than two variables written, mark only the first two.</i>	2 max
	b	type of soil/substrate ✓		
	c	pH level ✓		
	d	initial concentration of nutrients ✓		
	e	timespan of experiment ✓		
	f	volume of water/influent OR flow rate ✓	<i>Do not accept amount instead of volume.</i>	

2.	a	i		negative correlation between the number of leaves <u>removed</u> and transpiration rate OR as more leaves are removed the transpiration rate drops ✓	<i>Do not accept type of correlation alone, as a description is required.</i> <i>OWTTE</i>	1 max
		ii	a	transpiration does not only occur in the leaves OR transpiration through stem/shoot ✓		1
	b			number of leaves «removed» ✓		1
	c		a	using a potometer ✓	<i>Accept transpirometer but not respirometer.</i>	2 max
			b	leafy shoot attached to a reservoir and a graduated «capillary» tube ✓		
			c	as transpiration increases water uptake «by roots» also increases ✓		
			d	distance/time for bubble «in capillary tube» to travel is used to measure transpiration rate ✓		

3.	a		0.36 mol dm ⁻³ /M ✓	<i>Units required</i> Allow a range of 0.35–0.37 mol dm ⁻³ /M.	1
	b		osmolarity will increase «because the cells become dehydrated» OR the cells become hypertonic ✓	Accept water potential of the tissue decreases. Do not accept "change" instead of "increase".	1
	c		a the change in mass indicates whether the tissue has gained/lost water ✓ b the pieces of tissue will not all be the same mass «at the beginning of the experiment» ✓ c to compare the relative changes in mass ✓		2 max
	d		a water would move into the red blood cells ✓ b it would lyse OR swell OR burst ✓		1 max

Section B

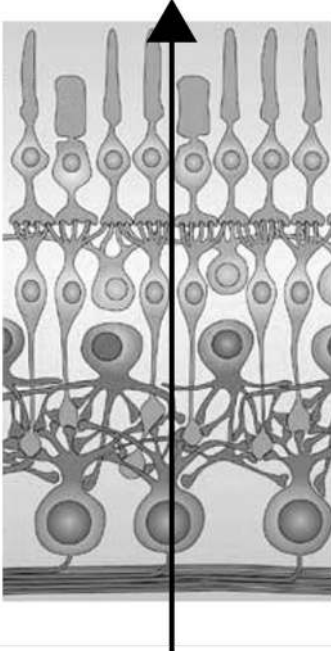
Option A — Neurobiology and behaviour

Question		Marking point	Answers	Notes	Total
4.	a	a	larger cerebral <u>cortex</u> in human brain ✓	<i>Do not accept larger <u>brain</u> for human as it is in the stem.</i>	1 max
		b	higher folding in human brain OR increased surface area in human brain ✓		
		c	angle of spinal cord more vertical in human OR angle of spinal cord more horizontal in sheep ✓		
	b	a	loss of unused neurons ✓	<i>Accept apoptosis or programmed neuron death.</i>	1 max
		b	loss of unused synapses OR reducing the number of synapses OR leaving more efficient synaptic configurations ✓	<i>Do not accept "connection" instead of "synapse".</i>	
	c		medulla «oblongata» ✓	<i>Do not accept "brain stem".</i>	1

(continued...)

(Question 4 continued)

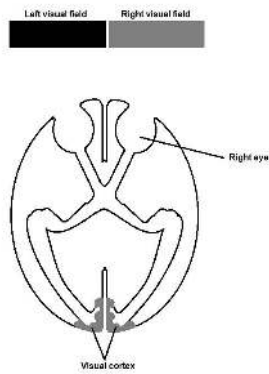
d	a	the brain contains a very large number of neurons and therefore consumes large amount of energy ✓	<i>OWTTE</i>	3 max
	b	«large» requirement for oxygen/glucose to provide energy for «aerobic» cell respiration ✓		
	c	energy used to sustain the electric charges of neurons OR energy used to sustain the membrane potential of neurons OR energy used to produce neurotransmitters ✓		
	d	brain has continuous activity that requires continuous supply of oxygen/glucose ✓	<i>OWTTE</i>	

5.	a		 <p>[Source: reprinted by permission from Springer Nature: Nature Reviews Neuroscience Parallel processing in the mammalian retina, Heinz Wässle, 2004, <i>Nat Rev Neurosci</i> 5, 747–757 (2004) doi:10.1038/nrn1497]</p>	Accept any arrow pointing upwards.	1
	b		A: bipolar cell B: ganglion cell ✓	Both required.	1
	c	a	mechanoreceptors «detect» pressure ✓	Mark only the first answer if more than one receptor is mentioned. Accept valid other receptors with the correct function.	1 max
b	chemoreceptors «detect» chemical substances/pH ✓				
c	thermoreceptors «detect» temperature ✓				

(continued...)

(Question 5 continued)

d			<i>Accept any of these points made on an annotated diagram.</i>	3 max
	a	«right» eye receives information/stimuli/light from both «left and right» visual fields ✓		
	b	light from the left visual field goes to the right side of the retina ✓	<i>Accept vice versa.</i>	
	c	impulses «from retina» carried along the optic nerve ✓		
	d	«optic» nerves cross at «optic» chiasma ✓		
	e	impulses from the left side of the retina go to the left side of the brain ✓	<i>Accept vice versa.</i>	



6.	a		chemical substance that transmits message across synapses/from one cell to another ✓	OWTTE Do not accept "connection" instead of "synapse".	1
	b		a interfere with neural transmission between areas of sensory perception and the CNS ✓		3 max
b	c	d	e	f	
	blocks nerve transmission/impulses to pain centres in the CNS ✓	inhibit the function of an ion channel «sodium channel» in nerve cells ✓	no changes in awareness/consciousness/sense perception in other areas ✓	suppress excitatory synaptic transmission ✓	
	OWTTE	Accept vice versa			
	c		a may cause the release of secondary messengers «in post-synaptic neuron» ✓		2 max
b	c	d	e	f	
	secondary messengers can persist for long time ✓	«secondary messengers» may enhance the synaptic connections between neurons OR «secondary messengers» strengthen neural pathways «involved in memory/learning» OR «secondary messengers» increase the number of receptors in the postsynaptic membrane ✓	OWTTE		
			modulate/reduce/increase fast synaptic transmission «in the brain» ✓		

7.	a	a	innate behavior is independent of environment ✓		1 max
		b	innate behaviour is controlled by genes/inherited ✓		
		c	innate behaviour is present at birth OR doesn't change through time/experience ✓	OWTTE	
	b	a	«courtship behaviour» is inherited/innate OR variations exist ✓	OWTTE	3 max
		b	fittest animals have the best courtship behaviour ✓		
		c	«courtship behaviour» allows members of a species to identify each other OR «courtship behaviour» results in mate selection ✓	OWTTE	
		d	«courtship behaviour» increases chances of mating/reproductive success ✓		
		e	«courtship behaviour» also make organisms more vulnerable to predation ✓		
		f	«allows» best courtship to be passed on to the next generation/offspring ✓		

(Continued...)

(Question 7 continued)

c	a	when an animal learns to associate a reward with a certain kind of behaviour OR trial and error learning OR positive reinforcement OR associative learning ✓	<i>OWTTE</i>	2
	b	example: animal training ✓		

<p>8. <i>General effects of any stimulant drugs:</i></p>	<p>[3 max]</p>	
<p>a. addictive/causes tolerance/addiction ✓ b. increase dopamine release ✓ c. speed up activity of CNS/alertness/euphoria/suppress appetite ✓ d. have symptoms of withdrawal when stop «chronic» use ✓</p>		
<p><i>Drug name:</i></p>	<p>[1 mark]</p>	
<p>e. name of «chosen» stimulant drug ✓</p>	<p>Award this mark for a stimulant drug only, e.g. nicotine, cocaine or amphetamines.</p>	
<p><i>Cocaine:</i></p>	<p>Award [3 max] for either cocaine, nicotine or amphetamines. Mark only the first drug explained.</p>	
<p>f. chronic use may cause psychological craving/paranoia/arrhythmia/hypertension/stroke ✓ g. cocaine attaches to dopamine pumps/transporters «on presynaptic membrane» OR blocks uptake/recycling OR causes dopamine to persist in the synaptic cleft ✓ h. amplifies synaptic transmission OR causes constant stimulation of postsynaptic neuron ✓</p>		<p>6 max</p>
<p><i>Nicotine:</i></p>		
<p>f. nicotine stimulates synaptic transmission of cholinergic synapses ✓ g. causes strong mood changes ✓ h. large doses have a calming effect ✓</p>		
<p><i>Amphetamines:</i></p>	<p>Accept ecstasy instead</p>	
<p>f. chronic use can «permanently» damage dopamine system OR cause problems with memory/learning ✓ g. amphetamines/ecstasy stimulate synaptic transmission of adrenergic synapses ✓ h. longer lasting effect than cocaine ✓</p>		

Option B — Biotechnology and bioinformatics

Question		Marking point	Answers	Notes	Total
9.	a		«frame 1 => ATG «frame 2 => TGC ✓ «frame 3 => GCC	<i>All three required. Order of frames is not relevant. Do not accept RNA, e.g. AUG.</i>	1
	b		continuous stretch of codons «between start and stop codon» OR can contain introns OR sufficient nucleotides to code for a polypeptide chain ✓		1
	c	a	«marker genes» are attached to target genes and inserted into bacteria/host cells ✓	<i>OWTTE</i>	3 max
		b	«marker genes» confirm that the target gene has been successfully integrated into the genome/ plasmid ✓		
		c	«marker genes» for antibiotic resistance/fluorescence ✓		
		d	antibiotic is added to the media used to grow the bacteria OR UV light is used «to detect fluorescence» ✓		
		e	genetically modified bacteria will survive OR successful transgenic organisms will fluoresce OR allow researchers to identify the bacteria that have been modified ✓		

(Continued...)

(Question 9 continued)

	d			electroporation OR microinjection OR biolistics/gene gun/gunshot ✓		1
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10.	a		blackwater OR brownwater/sewage OR feces OR organic solid waste OR paper pulp OR other biodegradable material ✓	<i>Do not accept methane and CO₂.</i>	<p style="text-align: center;">1</p>
	b		temperature: warm oxygen: low/anaerobic ✓	<i>Both required.</i>	<p style="text-align: center;">1</p>
	c		<p>a in batch culture product is withdrawn at the end of the «organisms » growth phases whereas in continuous culture product is withdrawn while the organism is growing / <i>OWTTE</i> ✓</p> <p>b in batch culture all of the growth medium/nutrients are added at the beginning whereas in continuous culture, growth medium/nutrients are added at a constant rate / <i>OWTTE</i> ✓</p> <p>c batch culture is carried out in large scale fermenters whereas continuous culture could be in small scale ✓</p> <p>d continuous can run for a longer time than batch ✓</p>		<p style="text-align: center;">2 max</p>

(Continued...)

(Question 10 continued)

	d			<i>Award marks for identification of the factor and description of the effect.</i>	2 max
		a	aerobic conditions achieved by stirring/aeration ✓		
		b	buffers maintain pH ✓		
		c	moderate temperatures maintained by cooling jacket ✓	<i>Accept mention of 20-30°C.</i>	
		d	product is collected during stationary phase ✓		

11.	a		<i>Aims [1 mark]</i>		2 max
		a	the addition of organisms to remove environmental contaminants OR the addition of organisms to convert toxic compounds to non-toxic products ✓		
			<i>Methods [1 max]</i>	<i>Accept other valid methods involving living organisms. Do not accept physical methods alone.</i>	
		b	physical and chemical procedures can be combined with bioremediation ✓		
		c	e.g. clean-up of oil spills using bacteria OR clean-up of heavy metals using plants and incineration ✓		
	b		to observe that it was stable OR to confirm that change was permanent OR to confirm that <i>merB</i> gene still present after many generations ✓		1

(Continued...)

(Question 11 continued)

c	a	used to clean up oil OR used to clean up mercury ✓		3 max
	b	used after other clean-up methods have been used ✓		
	c	nutrient concentrations have to be sufficient to support the maximal growth rate of the bacteria throughout the clean-up operation ✓		
	d	converts methylmercury into inorganic mercury «less toxic» ✓		
	e	converts oil into CO ₂ , water and simpler compounds «non-pollutant» ✓		
	f	produces extracellular digestive enzymes «lipase» ✓		

12.	a		production of pharmaceuticals OR proteins used in therapy OR antibodies OR vaccines ✓		1
	b		<p>a gene therapy involves introducing a normal copy of a defective gene into an organism ✓</p> <p>b virus/viral vector «genetically» modified for «safe» use ✓</p> <p>c insertion of desired gene/allele into viral genome/retrovirus ✓</p> <p>d an example is the use in SCID/lack of enzyme ADA in SCID ✓</p> <p>e removal of somatic cells ✓</p> <p>f introduction and insertion of the desired gene into the target cell OR modified virus can be introduced in the form of «inhaled» droplets OR the cells are introduced in the patient so that the desired gene can be expressed ✓</p>		3 max

(Continued...)

(Question 12 continued)

	c	a	«ELISA» uses antibodies to detect a target antigen «to a pathogen» ✓	OWTTE	2 max
		b	antigen attached to substrate ✓		
		c	the antibody «if present» will attach to the antigen ✓		
		d	«suitable» enzyme attached to antibody ✓		
		e	«enzyme» colour reaction shows the presence of antibodies to the antigen/pathogen ✓		

13.	a	used to test the presence or absence of a gene/allele OR used to diagnose the presence of a particular strain of virus/bacteria OR used to diagnose the presence of a specific mutation OR used to diagnose the presence of an expression of genes ✓		6 max
	b	DNA spots/probes/sequences attached to solid surface/microarray ✓		
	c	mRNA from healthy tissue/cell isolated and converted to cDNA OR mRNA from cancer tissue/cell isolated and converted to cDNA ✓		
	d	conversion to cDNA by reverse transcriptase ✓		
	e	fluorescent dye linked to complementary DNA/cDNA ✓		
	f	cancer cDNA colored with a different dye from the healthy cDNA ✓	<i>Accept named colour.</i>	
	g	cDNA binds to/hybridizes with probes «that have complementary base sequences» ✓		
	h	microarray rinsed to remove cDNA that has not hybridized ✓		
	i	microarray exposed to laser light which causes dye to give off light ✓		
	j	fluorescence shows which probes have hybridized OR fluorescence shows which sequences were in the tissue/sample ✓		
	k	hybridized probe shows gene expression OR hybridized probe helps in diagnosis of disease ✓		

Option C — Ecology and conservation

Question		Marking point	Answers	Notes	Total	
14.	a	a	higher FCR implies less sustainability ✓	<i>Do not accept efficiency instead of sustainability.</i>	2 max	
		b	salmon based diet is more sustainable/chicken is less ✓			
		c	salmon diet would have lower energy losses/chicken diet higher energy losses ✓			
		d	salmon diet will produce less waste/chicken more ✓			
	b			<i>Needs one advantage and one limitation to obtain [2]. Do not accept mentions of trophic levels.</i>	2 max	
		a	<i>Advantages:</i> food webs summarize all possible food chains «in the community» ✓			OWTTE
		b	realistic representation ✓			
		c	<i>Limitations:</i> some communities/ecosystems are too complex to represent ✓			
		d	only shows qualitative information/not quantitative data OR saprotrophs/abiotic factors not taken into account ✓			

(Continued...)

(Question 14 continued)

	c		<p>a</p> <p>«research demonstrates that keystone species» have a «disproportionately» large effect on their environment relative to abundance</p> <p>OR</p> <p>«keystone species» maintain a balance in the «stable» numbers of each species within a community</p> <p>OR</p> <p>«keystone species» have a large impact in preserving and stabilizing the biodiversity by preventing overpopulation/monopoly/out competition ✓</p>		1 max
			<p>b</p> <p>a keystone species' disappearance would start a domino effect/other species in the habitat would also disappear</p> <p>OR</p> <p>their loss leads to an imbalance in the food web</p> <p>OR</p> <p>their loss leads to a decrease in biodiversity ✓</p>	<p><i>Do not accept protecting keystone species prevents disappearance of other species since it repeats the question.</i></p>	
	d		<p>a</p> <p>the role of an organism in its environment</p> <p>OR</p> <p>functional position of an organism in its environment ✓</p>		2 max
			<p>b</p> <p>includes «spatial» habitat AND feeding activities AND interactions with other species in the community ✓</p>	<p><i>All required.</i></p>	
			<p>c</p> <p>no two species can occupy the same niche ✓</p>		
			<p>d</p> <p>a niche can be fundamental or realized ✓</p>	<p><i>OWTTE</i></p>	

15.	a		a	both show cases of entanglement/ingestion ✓		2
			b	sea turtles similar number of species affected by entanglement/ ingestion while baleen whales more species affected by entanglement than ingestion OR higher percentage of sea turtles species affected by entanglement/ ingestion than baleen whales OR higher number of species of «baleen» whales than species of sea turtles ✓	Do not accept answers quoting numerical values only.	
	b		a	plastic broken down into microplastics to be able to enter the food chain ✓		1
			b	plastic/microplastics become more concentrated at each trophic level ✓	Accept descriptions of biomagnification involving any of the species in the table.	

(Continued...)

(Question 15 continued)

c	a	presence/absence indicate environmental conditions ✓	<i>Accept named environmental condition/pollution.</i>	3 max
	b	changes in the environment affect these species ✓	<i>Number of species or type of species.</i>	
	c	«relative» numbers of individuals/indicator species can be used to calculate a biotic index ✓		
	d	changes monitored over time ✓	<i>Accept example of time frame.</i>	
	e	changes can lead to measures to protect the environment ✓		
	f	example of an indicator species AND what it indicates «e.g. Tubifex for sediment pollution» ✓	<i>Award marks for a species, not a group.</i>	

16.	a		organisms remain in their own habitat OR protects a large number of organisms/species/habitats simultaneously OR protects natural interactions within the community OR «corridors» facilitates natural processes of evolution/adaptation ✓	<i>Mark only the first answer if many provided.</i>	1	
		b	a	increases edge effect and thus biodiversity OR maintains genetic diversity OR prevent the negative effects of inbreeding ✓		<i>Mark only the first answer if many provided.</i>
			b	also help facilitate the re-establishment of populations after catastrophic events ✓		<i>Accept named catastrophic events e.g fires, diseases, etc.</i>
c	increases availability of food resources ✓					
c	c	a	a stable/balanced ecosystem OR high species richness/evenness ✓		1 max	
		b	ecosystem not under stress ✓			
		c	ancient ecosystem OR absence of changes ✓	<i>Accept final stage of succession, climax community.</i>		

(Continued...)

(Question 16 continued)

d	a	size and shape determine the length of perimeter/edge OR smaller or irregular shapes have «relative» greater «perimeter and» edge than larger/round ✓	<i>OWTTE</i>	3 max
	b	perimeter determines importance of edge effect OR edge effect is the result of interaction between adjacent ecosystems OR edge effect results in abrupt change of habitats ✓		
	c	greater edge effect results in increased biodiversity OR greater edge effect leave organism exposed «to abiotic factors or predators» OR greater edge effect allows for the influx of new species/predators ✓	<i>Accept vice versa for smaller edge. Accept greater variety of resources or more ecological niches for biodiversity.</i>	
	d	large areas can conserve a greater number of habitats OR larger areas give more protection against human interference/influence/pollution ✓	<i>Accept vice versa for smaller areas. Accept greater variety of resources or more ecological niches for habitats.</i>	
	e	large areas make it easier for poachers to go undetected. OR smaller areas may have too few resources for long-term survival ✓		
	f	corridors promote movement between habitats /genetic variation OR smaller areas connected by corridors have greater edge effect than those without corridors ✓		

17.	a		iron/Fe ✓		1
	b	a	« <i>Rhizobium</i> » forms mutualistic/symbiotic relationship with roots/legumes ✓		2 max
		b	« <i>Rhizobium</i> » fixes «atmospheric» nitrogen ✓		
		c	converts it into ammonia «to be used by plants» ✓		
	c	a	normally shallow ✓		2 max
		b	low water visibility OR high levels of nutrients/phosphates/potassium OR low oxygen concentration OR high BOD ✓		
		c	high net primary productivity OR algal bloom OR low biodiversity ✓		

18.	a	named species ✓	<i>Do not award marks for group of animals eg birds. Do not award the mark for this point if the method doesn't apply for the species.</i>	6 max
	b	capture and count a sample of the population ✓		
	c	example of method of capture ✓		
	d	apply a mark that will not affect the survival of the animal «e.g. non-toxic paint spot/ear tag/leg ring/radio transmitter» ✓	<i>OWTTE</i>	
	e	release the organism into the environment ✓		
	f	allow time to become randomly dispersed ✓	<i>OWTTE</i>	
	g	capture «a second sample» and count the complete sample ✓		
	h	count the marked individuals in the second sample ✓		
	i	define formula to estimate the population size ✓	$N = \frac{n_1 \times n_2}{n_3}$ <p><i>where n_1 = first capture, n_2 = second capture, n_3 = number marked in second capture. Accept alternative displays of formula, e.g. different variables, wording displayed in a formula, etc.</i></p>	
	j	only estimates could be obtained ✓		

Option D — Human physiology

Question		Marking point	Answers	Notes	Total								
19.	a		<table border="1"> <tr> <th>essential amino acids</th> <th>non-essential amino acids</th> </tr> <tr> <td>cannot be synthesized by the organism</td> <td>can be made from other amino acids</td> </tr> <tr> <td colspan="2" style="text-align: center;">OR</td> </tr> <tr> <td>need to be ingested in diet</td> <td>don't need to be ingested in diet ✓</td> </tr> </table>	essential amino acids	non-essential amino acids	cannot be synthesized by the organism	can be made from other amino acids	OR		need to be ingested in diet	don't need to be ingested in diet ✓	<i>Distinctive elements from the same line required to gain the mark.</i>	1
			essential amino acids	non-essential amino acids									
			cannot be synthesized by the organism	can be made from other amino acids									
			OR										
need to be ingested in diet	don't need to be ingested in diet ✓												
b	Indian diet based on rice and wheat which have low levels of lysine OR low levels of meat/milk in Indian diet OR high levels of meat/milk in UK diet ✓		1 max										
				c	a protein/muscle lost for energy ✓ b lack of blood plasma proteins ✓ c leading to tissue fluid retention/edema/swollen abdomen/kwashiorkor ✓ d lethargic/little interest in surroundings ✓ e thin muscles/flaky appearance of skin/sparse hair with lack of pigmentation ✓ f physical/mental development retarded ✓ g lack of menstrual cycle ✓		2 max						

(Continued...)

(Question 19 continued)

d			<p>cod/fish liver oil OR oily fish «accept correctly named example» OR egg yolk OR «fortified/enriched» dairy product ✓</p>	<p><i>Allow any two sources for the mark. Mark only the first two. Do not accept sunlight, as source has to be dietary, nor dietary supplements. Reject fish alone.</i></p> <p><i>Check examples on the Internet if necessary.</i></p> <p><i>i.e. milk/cheese/yoghurt.</i></p>	1										
e			<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">cause</th> <th style="text-align: center;">symptom</th> </tr> </thead> <tbody> <tr> <td>body becomes resistant/not responsive to insulin</td> <td>hyperglycemia/high glucose content in blood/urine</td> </tr> <tr> <td>pancreas does not produce enough insulin</td> <td>thirst</td> </tr> <tr> <td></td> <td>frequent urination</td> </tr> <tr> <td></td> <td>other valid symptom ✓</td> </tr> </tbody> </table>	cause	symptom	body becomes resistant/not responsive to insulin	hyperglycemia/high glucose content in blood/urine	pancreas does not produce enough insulin	thirst		frequent urination		other valid symptom ✓	<p><i>Both one cause from left column and one symptom from right column required for the mark.</i></p> <p><i>For the cause, do not accept risk factors, e.g. high sugar intake/obesity, lack of exercise, genetic predisposition, etc.</i></p> <p><i>Other valid symptoms could be: slow-healing sores, dizziness, tiredness, red/swollen gums, kidney/back pain, nerve damage, erectile dysfunction.</i></p>	1
cause	symptom														
body becomes resistant/not responsive to insulin	hyperglycemia/high glucose content in blood/urine														
pancreas does not produce enough insulin	thirst														
	frequent urination														
	other valid symptom ✓														

20.	a		as age increases liver transplant due to cancer increases ✓		1
	b	i	a hemoglobin taken up by Kupffer cells ✓	<i>Do not accept confusion between erythrocytes and hemoglobin.</i>	3 max
b	broken down into heme and globins ✓				
c	globin hydrolysed/broken down to amino acids ✓				
d	iron removed from heme group OR heme broken down to form bilirubin/bile pigment ✓				
		ii	a storage of nutrients ✓	<i>Accept only the first answer if more than one are provided.</i>	1 max
b	regulation of blood glucose levels ✓	<i>e.g. glucose to glycogen and vice versa.</i>			
c	production/secretion of bile ✓	<i>Do not accept production of bile <u>pigments</u> from hemoglobin in the liver.</i>			
d	detoxification ✓				
e	synthesis of plasma proteins e.g. albumin ✓				
f	synthesis and regulation of cholesterol ✓				

(Continued...)

(Question 20 continued)

	c		cellulose/lignin/fibre OR bacteria ✓		1
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21.	a		improvement in medical care OR healthier diet OR decrease in blood cholesterol/pressure OR decrease in cigarette smoking OR increase in exercise ✓	Accept improvements in medication. Accept other answers relating to greater awareness about health issues.	1
	b		a used in life-threatening cardiac conditions/arrhythmia/ventricular fibrillation ✓ b delivers therapeutic/small dose/shock of electrical energy ✓ c depolarizes the heart muscle OR allows normal rhythm to be re-established ✓		2 max
	c		a «heart sounds» produced by the closing of the valves ✓ b first sound «lub» is due to «closure of» the atrioventricular valves ✓ c second sound «dub» is due to «closure of» the semilunar valves ✓ d sequence of sounds from a healthy heart is lub dub «pause lub dub pause» ✓	Accept bicuspid/mitral and tricuspid. Accept pulmonary/aortic valves. OWTTE	3 max

22.	a		growth hormone/drug no longer present «in blood» OR lack of hormones reduce «gained» muscle mass/strength ✓	OWTTE	1	
	b		<p style="text-align: center;">steroid hormones</p> <p>a enter the cell/pass through the <u>plasma</u> membrane</p> <p>b bind to receptor in cytoplasm</p> <p>c act directly on DNA</p> <p>d directly affect gene transcription</p>	<p style="text-align: center;">peptide hormones</p> <p>do not enter the cell/pass through the <u>plasma</u> membrane ✓</p> <p>bind to receptor on <u>plasma</u> membrane surface ✓</p> <p>act through second messenger/cAMP ✓</p> <p>influence enzyme activity/protein kinase ✓</p>	Award [1 mark] for each complete row, up to [3 max]. Apply ECF the second time <u>plasma</u> is omitted and award the mark	3 max
	c		<p>a endocrine gland ✓</p> <p>b «ductless gland that» secretes hormones directly into the bloodstream ✓</p>		2	

23.	a	exercise increases the rate of cellular respiration ✓		6 max
	b	increases production of CO ₂ ✓		
	c	increased CO ₂ causes increased acidity in blood OR decrease pH ✓		
	d	chemoreceptors in aorta/ carotid artery/medulla oblongata detect change in pH ✓		
	e	impulse/signal/message to breathing centre OR impulse/signal/message to medulla oblongata ✓		
	f	impulse/signal/message to to diaphragm for more frequent contraction OR impulse/signal/message to intercostal muscles for more frequent contraction ✓		
	g	increase ventilation rate for more gas exchange ✓		
	h	long term effects of increased lung surface area OR vital capacity ✓		
	i	training decreases ventilation rate over time ✓		